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PROCEEDINGS OF THE PITTSBURG FOUNDRYMEN'S ASSOCIATION.

An interesting and instructive address was delivered at a recent meeting of the Pittsburg Foundrymen's Association by Mr. S. H. Stupakoff, who had consented only two or three days before the meeting to take the place of Dr. Kemery, who was to have delivered an address upon a different subject. Mr. Stupakoff's subject was "Foundry Records." He felt that all should have something to say on so vital a subject. The questions a foundry manager or superintendent is always asked regarding the proposed casting are: 1. How much will it cost? 2. How soon can it be obtained? 3. What will be required to make it? The manager can generally tell what he will need, but to arrive at the cost of producing the casting it is necessary to divide cost into these heads: 1. Material., 2. Lat r.

To follow up the cost subject properly, a man does not need a profound knowledge of book-keeping, but he must have sound judgment. In every foundry there are employed molders, clerks, shippers, etc., and if advisable, these items of labor may be separately dealt with. Likewise, in material, separate accounts may be kept for the different kinds of material, pig iron, coke, gas, sand, facings, etc., and sieves, shovels and other tools. If de-

sired, the iron may be divided into pig iron and scrap, and in turn the pig iron may be subdivided into the different brands and the scrap into the different varieties. Supplies would make another heading, and labor the last heading. If it is possible to record the consumption of materials and labor, taking into account the varying costs of different qualities, then it is possible to predict the cost of future castings when certain data are given.

Recently the manager of a certain foundry said that the foundry was over-producing, this foundry being an adjunct to a large manufacturing business. It was answered by the man who had charge of the records that the foundry had produced in five and a half months so many hundred thousand pounds of castings, the number being between 700,000 and 800,000 pounds. In the period the over-production proved to be but 11,000 pounds, which could have been made in one day. Such a foundry as this is run on entirely different principles from a jobbing foundry, which works on orders entirely. It has the advantage of being able to fill up at times with castings which may be expected with certainty to be called for in the next two or three months, but even in such a case there must be no guess work, and here is a place where foundry records are absolutely essential, because from these records can be learned how many pounds of a given class of castings are customarily used in a given time, how many are in stock, etc.

To supply the information required in this connection, the storekeeper was required to get up a book for castings in his charge. To show the magnitude of the work, it should be stated that the storekeeper has to have not less than 3,500 different headings and sub-headings, this being the number of different castings which were expected to be in stock. The first column under each heading starts out with the stock on January 1, followed by the castings made from time to time. The next column gives the withdrawals made from time to time, and these entries, by the necessary subtraction and addition, give the results for the third column, which shows the number or weight of castings on hand at any time. The storekeeper sees also in the second column

the number which is likely to be called for at any time, and by using his judgment can determine the maximum and minimum number of castings which should be kept in stock. In order to keep these records properly it is necessary to have all the castings go through the store-room, and to check the records it is necessary to have evidence from the producer and from the receiver. So there is a daily foundry report sheet, giving the production, and this is verified by the storekeeper from his figures of the castings received, while the evidence from the other end comes in the shape of requisitions, coming from those who receive the castings, these requisitions being kept by the storekeeper and furnishing a check on his figures of withdrawals. These foundry report sheets and the requisitions are systematically filed by the storekeeper. The foundry foreman keeps the records of production, entering on the slips the weight and number of castings. For each workman there is a printed slip, one style for day workmen and another for piece workmen. In this foundry as much work as possible is put out on the piece system, and the rule is in force not to pay for bad castings. The practice was started half a dozen years or so ago, and having no trouble with it, it was made a part of the contract. On these slips are spaces for the date, employe's number, etc., and columns for the order number, date, number of hours, number of pieces, description of article, and price, each piece occupying one line and all the data regarding it being thus given.

This is all detail so far, without any determination of the cost. The slips must all be turned in to the time-keeper, or the men will not be paid, and the time-keeper then finds from the data furnished the time worked. If castings prove bad in the foundry they are so entered at once, but if they prove bad afterward, in the machine shop, when the slips have been turned in to the time-keeper, then the word is passed to him, and he makes the proper entry. In this way the exact amount of time required is ascertained, because all the time put in is accounted for, and bad castings are all charged up, so that the time is not made to appear less than it really is on an average.

For the manager's own use there is a large sheet, on which are entered all the results. There is a separate sheet for each month. It contains a large number of columns, showing all the materials used, the labor, with its cost, the number of castings made and the weight withdrawn, the cost per 100 pounds of castings, and the average weight of the castings. From the data as entered on this monthly sheet, it is possible to determine the cost of castings. The average weight of castings in the foundry in question is five pounds.

At the close of the address, of which the above is a summary, President Yagle said the meeting would be glad to hear from Mr. Sleeth, who stated that in the works with which he is connected they follow a somewhat similar system. They cast from 5,000,000 to 6,000,000 pounds a month, making from 30,000 to 40,000 pieces a day. They have a daily record which is entered into a monthly sheet. They charge the purchases of iron during the month and take account of the stock at the beginning of each month, by which means the consumption of iron is obtained. This rule is to count the work and not the molds, the result being so many good castings and so many bad ones. Mr. Sleeth related an anecdote of his experience when a boy. He was in a foundry where the foreman counted the number of molds, with the result that the molders imposed on him a great deal by just making a hole in the sand and having it poured, thus getting credit for a casting which went right into scrap. The system of the speaker's company is to consider pig iron the only real material, as it is the only thing going into the finished casting; everything else is lost, including labor.

Mr. Taylor called attention to the fact that the methods applicable to fundries where there was a regular run of work were of no use in a jobbing foundry, and complained that they were continually losing. He mentioned the case of a 400-pound casting on which a price of $10 was fixed in advance. It had been figured that the molder would take half a day, but the result was a cost for the casting of $11.25, when the selling price was only $10.

Mr. Stupakoff said there certainly were some kind of records kept in jobbing foundries. By taking into account the cost of the pig iron, etc., and then at the end of the year comparing the receipts, it would be possible to sum up all the extras and find out what must be added to the figured cost of a casting to make it come out right in the general summary.

Mr. Taylor said they did keep records, but he did not like to say how. He had the figures for the case he had brought up, as follows: Iron, $3.25 (allowing 25 cents for melting); molding, $2.75; core-making and material, $2.50; lumber and carpenter work, $1.25; chipping, $1; delivering, 50 cents; making a total of $11.25. He did not like to give away figures, but here they were.

A REVIEW OF THE FOUNDRY LITERATURE OF THE MONTH.

IRON AGE.

In the issue of July 6, this journal says editorially under the heading, "The Approaching Iron Famine":

"The predicted shortage in pig iron is beginning to be felt, particularly in foundry irons in the West. Instances are coming to light of foundries being obliged to shut down for several days awaiting receipts of needed raw material. So far it is believed that the trouble has been caused by the non-arrival of special brands desired for the usual mixture on which the foundry has been running or to the deferring of purchases a little too long to secure shipments in time to insure steady operation. But it is nevertheless a fact to be considered that the stoppage of foundries for lack of any kind of pig iron is a new experience in the trade which points to further trouble of the same character. While many consumers of iron are forehanded and are extremely careful not to run short in any part of their supply, a considerable percentage will always fight advancing prices and will buy from hand to mouth, expecting continually to be able to do better for themselves a little later. These are the people who are paying premiums for immediate delivery and are thus running up prices beyond the quotations at which time contracts can be made. Enough of them are found in every iron consuming center to give increasing strength to a naturally strong market. From present appearances it will not be long until the slow buyers shall have taken all the available supply of pig iron without regard to brand and the famine will then be appreciated in earnest.

"Much inconvenience is being experienced in other branches of trade by reason of the extraordinary pressure for iron and steel. Work is being delayed on bridges and buildings because essential parts are not being delivered in time. It also extends into small wares, manufacturers using malleable castings being obliged to wait unreasonably long for the delivery of pieces needed to finish work which they have in hand. Annoyances of

this character are being seriously felt in the hardware trade. Those who are still skeptical about an iron famine need only to interview a few manufacturers and consumers to unearth convincing evidence."

Quoting from "The Metal Worker" the "Iron Age" has the following in its issue of July 20th:

"An interesting comparison between the boom periods of 1879 and 1899, as affecting the stove trade, has been made in a paper contributed to The Metal Worker by Franklin L. Sheppard, in which he touches upon one important point which many industries are beginning to suffer from. We cannot do better than to quote his words: 'Wages have been advanced, and are to-day upon the highest level yet known. For five years past, just as in the five years preceding 1879, foundries have been running at less than their full capacity, and very little attention has been paid to the training of apprentices. When skilled journeymen could not obtain employment there was little inducement for boys to learn the trade or for employers to teach them. During these years numbers of foundrymen have retired from the business of stove manufacture, and there has been no recent increase in foundry capacity. The trade this fall will pay the penalty of this indifference. Even poorly trained stove molders are scarce, and good molders are scarcer. There are very strong indications that between a shortage of material and a shortage of labor, stove foundry managers this fall will find their hands full in the effort to supply their customers with reasonable promptness.'"

Under the caption "Charcoal Iron Regaining Favor," this journal says in its issue of July 27:

"Not many months since, an unintentional injustice was done in these columns to the Lake Superior charcoal pig iron trade. At that time appearances pointed strongly to the permanent relegation of charcoal iron to an inconspicuous position in the ranks of blast furnace products. Consumers would pay no premium for charcoal smelted pig over the price asked for the same grade

of coke pig. No special favor was accorded it even among those time honored friends, the makers of car wheels, who went so far as to declare that old car wheels had points of superiority over new charcoal pig and were worth more for their purposes. For a time market quotations seemed to verify the correctness of their position. Lake Superior charcoal furnace companies were obliged to keep their prices close to those of coke iron, or they made few sales.

But an error was committed in regarding the conditions then ruling as in any degree permanent. When the revival came in the iron trade the special qualities of charcoal pig were again an independent basis of value was established, which is shown in the elevation of prices above those asked for coke iron. As for old car wheels, they have been left far in the rear, and apparently cut no figure whatever in fixing the value of charcoal iron. The pressure for the high numbers of Lake Superior charcoal pig has, in fact, been especially strong for some time, showing that a keen demand for that class of iron is coming from car wheel makers. This development shows the danger of drawing conclusions from conditions prevailing in times of abnormal depression.

IRON TRADE REVIEW.

The Iron Trade Review addressed inquiries to a number of foundry firms in different parts of the country, asking what advances had been made on recent contracts for castings, whether long-time contracts were being made for castings on the basis of current prices, and whether there were any indications of a curtailment of the demand for castings because of high prices. Some of the replies to these inquiries are given below:

The Union Malleable Iron Co., Moline, Ill., F. W. Gould manager, writes as follows:

"We have sold our entire output up to July 1, 1900, as an advance of about 25 per cent over last year's prices. To your question relating to check upon consumption because of advance in price of pig iron we reply, most assuredly yes. The implement and vehicle manufacturers believe there will be a considerable

decrease in business and accordingly their contracts with us are smaller than for last season."

J. G. Sadlier, of the Springfield Foundry Co., Springfield, O., says:

"Within the last 30 days our company has not done very much in the way of making contracts for castings. We have adjusted contracts of our regular customers generally to conform with the advance in the price of labor and material. For such work as we are now taking on, ordinary machine castings, we are contracting at 3 cents per pound, and architectural castings at 3 cents to 3¼ cents. We do not find that the advance in pig iron is having any tendency whatever to check the consumption of gray iron castings. We are receiving large orders right along from our customers, and our foundry is running full force full time. We have on our books all the time large orders for castings."

Concerning conditions in Cleveland as reflected in the heavy foundry trade, Mr. N. P. Bowler, of Bowler & Co., writes as follows:

In compliance with your request I give you a few prices of castings of this date (June 30): Rolling mill castings, 2½c; machinery castings 2⅝c to 2¾c; pulleys, common, 3c to 3½c. This is an advance from April prices. The orders for castings from our customers are too imperative to be checked by any reasonable price that may be asked. The foundrymen of this city are bearing part of the increase of material and labor, and a further increase in their prices seems to be a necessity before very long. The price of castings through 1898—for machinery, architectural and heavy kinds—averaged about $35 per ton of 2,000 pounds. Every foundry now seems to be busy and most manufacturers think it will keep so for a year or so."

A New England jobbing foundry, writing under date of April 25, commented as follows on the conditions then existing:

"Our business has increased very rapidly and we have advanced prices a good deal. We were melting about 55 to 60 tons per day the first of the year and have increased it to about 80

tons per day. We make all kinds of castings from small work weighing part of an ounce each up to castings weighing many tons each. On low-priced work made largely of scrap iron for which we formerly got $1 to $1.50 per 100 pounds, we have advanced 30c to 50c per 100 pounds. On castings for which we got from $1.50 to $2.50 per 100 pounds, the advance has usually been from 50c to 75c per 100 pounds. On castings from $2.50 to $4 per 100 pounds we have advanced prices usually from 75c to $1 per 100 pounds, and on castings above $4 per 100 pounds, the advance has been anywhere from $1 to $3 per 100 pounds. In our opinion the outlook for trade is the best we have seen since we started business 20 years ago. We think many of the foundries have not advanced the prices as much as they should do for their own interests as well as for the good of the manufacturing business in general. We are refusing to quote on a good deal of work, as we are too busy to make it."

The same firm writes as follows under date of June 29:

"There have been heavy advances in the price of castings since April. We are not making any time contracts whatever these days, as we do not wish to tie ourselves up to do so, and we do not think others are making them to any extent. Should think the advance since April on heavy castings has been from ½ to 1 cent per pound, and on small bench work castings 1 to 3 cents per pound. We are compelled to refuse to quote at all on a large amount of work that is offered, as we are not able to supply the demand. We find the foundries in this vicinity are very busy indeed, and many of them unable to meet the demands made upon them for castings. We have not seen any signs as yet of the increased cost checking consumption."

O. T. Stantial, of the Illinois Malleable Iron Co., notes increasing consumption:

"Prices on malleable and gray castings have steadily been advancing to conform with the advance in pig iron and raw materials, and advance in labor, both molding and common labor. On light gray castings the advance has been from $10 to $15 per

ton over the low prices ruling some time ago, and upon light malleable castings about the same advance. In our lines the advance in pig iron does not seem to have exerted any check upon consumption. In fact, consumption all along the line seems to be increasing steadily. We are far behind on our orders, and have experienced very little difficulty in advancing prices, both to cover additional cost of material and labor, and also to yield us considerable better margin of profit than heretofore. What influence upon consumption a still greater advance in the cost of pig iron and material will exert it is difficult to say. It is becoming plainer every day that there is a true shortage in the supply of pig iron, and it is becoming difficult to obtain it even at ruling high figures."

The Dobbie Foundry & Machine Co., Niagara Falls, N. Y., writes, July 3:

"Since December we have advanced prices on iron and brass castings 50 per cent. We are crowded with orders and the outlook for future business is good."

Writing under date of April 26 the same company said:

"The prices we received for castings in 1898 were about the same for the entire year. Since December we have made advances in prices as follows: Machinery castings, from 2c and 2½c to 2¼c and 3c; light gray castings, from 3c to 3¾c. We are melting several hundred per cent more iron than at this time last year, and the outlook is that the record for this year will be the same proportion. We have more inquiries from all over the country and our export trade is good."

A Western Pennsylvania foundry makes this report:

"In the last two months there has been a greater advance in the price of iron castings than in any like period previous, averaging we would say ¼ cent per pound. The foundries seem to be more pushed than at any time. The —— Co. gave out a small order for four housings about five tons each, for which they paid 1.50c per pound. We have just refused an order for 200 tons of fairly easy castings, averaging 100 pounds each, for which we

were offered 1.77c here, with a little fitting which would not amount to .02 cent per pound. The —— Co. have given notice they will advance their molders on July 1, so that their wages will be from $2.75 down, and this company will have to meet this rate. Outside of the skilled labor in the foundry, we pay much better wages. We see no signs of a check in the demand for new material; but in our line, which is special, this would not be so noticeable."

Geo. McG. Morris, of the John B. Morris Foundry Co., Cincinnati, O., believes foundrymen should unite to secure material benefits from the present situation:

"The outlook for the foundry trade in general is to-day the brightest it has been for years in this section of the country. The great drawback is the failure of the foundrymen to grasp the situation and take advantage of the advances in material and labor. The stagnation of the market in all manufactured articles for the past few years has caused a clamor for work to keep the large plants in operation and consequently cut after cut in prices, until some castings were sold at a very slight advance over the cost of pig iron.

"Now is the opportunity of the foundrymen to get those prices restored, the best opportunity they have had in years and will have again for some time to come. Why not embrace it while it lasts? Some foundrymen argue that they have contracted for their material for a period in advance and therefore can afford to make work at lower prices. 'What fools these mortals be!' If a man has foresight enough to take advantage of the low prices of material, he is certainly entitled to reap the benefit of the profit derived therefrom. There is another drawback in the foundry business, the easiest of all to overcome, but which through jealousy and fear seems to be the hardest. That is the unscrupulous consumer who uses one man's price to beat down the other, sometimes truthfully, but more often untruthfully. This is a growing custom among the consumers of our products, and how easily it could be stopped if the foundrymen would only consult one an-

other. Let them get together on friendly terms and they will soon learn how they are being duped.

"In Cincinnati 'machinery castings' were being made in the latter part of April at figures ranging from $1.75 to $2.25, architectural castings from $1.50 to $1.90, light gray iron castings from $2.50 to $3.50. [In the last two months considerable advances have been made.] Nearly all the engine work is made by the builders themselves, who own their own foundries. There are no railroad or rolling-mill castings made here, and we have only one small malleable shop.

"In closing I will again appeal to the foundrymen to take advantage of the present times and get their prices up, as we do not know how long pig iron will remain at the present high prices, and if it once starts to go down the time will be past and the golden opportunity lost."

In a review of the technical press, Dr. R. Moldenke notes an interesting lecture delivered before the Berlin Society for Industrial Advancement by Capt. Henning, in which the author says that it is especially gratifying to note that the disinterested work of our American foundrymen has been duly appreciated by their European brethren, and that an era of study and unprejudiced practice thus inaugurated in the foundry world is bidding fair to restore much of the lost ground chargeable to our imperfect knowledge of the materials we deal with. After referring to present tendencies in the arts, especially the ones dealing with iron and steel, Capt. Henning shows that in order to satisfy the demands made upon modern structural material, the old methods of trying to fill the bill would no longer do, and exact and advanced methods are required. Here chemistry will do wonders for us in providing a satisfactory and absolute reliable starting point in our works, whatever we may do with it later. Given a proper mixture to charge into the cupola, barring accident or carelessness, the results will come out right.

In this study of the real nature of cast iron as a basis for further improvement the work of all our investigators when thoroughly digested and put together, forms a very valuable contribu-

tion to foundry science and practice. Thus the effect of the impurities in iron are noted: the melting temperatures, the composition of the fuel, molding sand, and the various classes of iron discussed. The importance of buying by analysis is thoroughly ventilated, which shows that foundrymen in Europe are arriving at the same conclusions in this regard as we are. It may be interesting to compare the average composition of foundry irons used in Europe with ours:

	American.	Luxemburg.	English.
Total carbon	3.5 —4.0	3.3 —3.7	3.0 —4.0
Graphite	3.0 —3.3	2.6 —3.5	2.6 —3.5
Silicon	2.4 —3.2	1.8 —2.5	1.7 —3.4
Manganese	0.3 —1.2	0.4 —0.9	0.5 —1.8
Phosphorus	0.3 — .8	0.5 —0.8	0.4 —1.4
Sulphur	0.02—0.05	0.02—0.05	0.01—0.10

The lecture concludes with series of tables of physical tests on German test bars, which show that in spite of our advantages in quality of fuel and iron, very creditable results are obtained on the other side. In the discussion which followed, attention was called to the lack of homogeneity in the iron tapped where the pieces of scrap are heavy or where an iron high in phosphorus is mixed with another quite low in this impurity. Moreover, instances were cited where white irons in a mixture which melted first gave hard castings, though soft ones were expected and came later on. This goes to show the danger attending the mixing of extremes in composition in the cupola. In closing the discussion Mr. Kirchner, editor of the Eisenzeitung, described the methods pursued in the American Foundrymen's Association series of tests for obtaining the great number of bars at practically the same casting temperature.

In the issue of July 13, Mr. E. C. Wheeler, of Dayton, O., has an article on "Pig Iron for Malleable Castings," which we reproduce in full:

PIG IRON FOR MALLEABLE CASTINGS.

There has existed for a considerable period, a feeling of uncertainty among blast furnace managers concerning the require-

ments of the malleable iron casting industry, on specifications for pig iron. This has been occasioned in a great measure through the disinclination of buyers to state any too clearly the limits desired in percentages of impurities, and thereby compelling furnaces to produce iron, which varied in the gradings from No. 1 to No. 7. Years ago, during the early progress of this industry, charcoal iron was the only raw material considered, and is to-day in many quarters the only metal charged into the reverberatory furnaces. Charcoal iron has never lost for a moment its position in the malleable foundry; but the production being so limited, its place has been taken by the advent of the cheaper coke irons. Chemistry was an unknown factor both in blast furnace practice, and malleable works; and when the air furnace was charged with the charcoal burden, the latter was continued under heat influences until the combination of the carbon with the metallic iron had been effected. The duration of heat varied greatly, of course, and this difference in heat operation was very naturally laid to inequalities in the pig iron. This explanation seemingly went no further, as the idea of metalloids affecting the composition of metal, had not then been projected. There were no limits placed upon silicon, sulphur, phosphorous or manganese; and outside of carbon very little was really known of the metal. The real variety came in the grading, and we must admit now the careful manner in which metal was selected for malleable cast iron.

There are many malleable concerns which dispense with the services of a chemist, and to-day it seems more consistent, as they are furnished by blast furnaces with carefully determined analyses from which heats are calculated; and in a casting industry a chemist's real territory commences with results, rather than checking up initials. There is hardly a blast furnace extant, which is run without a laboratory, and analyses are always furnished. It would be a retrogression for any one to maintain that just as good material was produced in the old days of the industry as now, and there is no likelihood of the admission being made, that nothing has been learnt in 40 years of business.

From an intimate association with blast furnace practice, and some little experience in malleable cast iron founding, the writer begs to present a few deductions so gathered. It is hoped that while they are the result of practices purely local, they may strike some points of interest to others, whose experience covers somewhat similar lines. In an industry like the malleable, where it is said that no two furnaces work exactly alike, greater variance of ideas may be expected than in steel. But in following these deductions the writer has made fairly good material, and in thus presenting them, trusts they will contain some interest for all.

HEAT INFLUENCES ALL-IMPORTANT IN MALLEABLE.

Malleable casting, like its companion art, gray iron founding, is greatly a matter of local practice, and only general principles hold good. If no two furnaces work alike, as has been stated, it is more a question of heat influences, than a chemico-physical one requiring an entirely radical change in mixtures; for it is not within the limitation of sound reasoning to suppose that one foundry placing all its confidence in, say, phosphorus, and another in silicon, would arrive at the same results, with the same satisfaction and confidence. If the above is a fact, and the writer has good reason so to believe, then we are reaching our ends through the disregard of some very important associate influence, without acknowledging its presence. Pig iron is the same, all over the country, and does not act peculiarly in localities.

The most advantageous movement in the direction of uniformity in malelable calculations, would be the establishment, to the satisfaction of all concerned, of what really is the one dominant metalloid in pig iron. We believe from their daily association with its many phases, that the blast furnace managers are the ones to decide this point. In the calculating and mixing of irons for the malleable burden a mixture is desired which will have, when the metal is hot enough to pour, all of its carbon in combination with the metallic iron, and if, when the metal is hot enough to tap, this said condition has not been effected, and iron is held in furnace under continued heat influences, then the initial calculation has been at fault. Therefore it might be said that if

blast furnaces could supply malleable foundries with an iron having a great proportion of combined carbon, the ideal metal would be at hand; and so it would, if combined carbon were a controlling influence, as graphitic carbon is. Combined carbon is present in large percentages only when the heat condition of original casting at blast furnace has been very low, and if a heat were charged into the reverberatory furnace of this iron, the metal would only be suitable for the casting of heavy shapes, as its own native heat is very low. Pig iron high in percentages of graphitic carbon has been produced under high thermic conditions at the blast furnace, and such iron is high in fluidity, through its association with an element which always stands for latent heat, namely silicon. When pig iron is high in percentage of combined carbon and necessarily low in latent heat, it does not derive any advantage from a metalloid present, and one which is an acknowledged factor for fluidity, namely, phosphorus, because there has not been enough heat present in the metal to free it. The action of phosphorus in conjunction with silicon is apparent to all careful observers, both in gray iron and malleable founding.

SILICON THE INFLUENTIAL METALLOID.

In view of the foregoing facts, we must turn to silicon as the most influential factor in pig iron, and together with furnace conditions it is certainly the governing element in all irons from the No. 1 to No. 7, charcoal or coke. The other metalloids are void of effect, if the silicon is not prominent enough to give metal sufficient life, and thus enable them to free themselves to act. Silicon in pig iron is purly the result of a blast furnace heat condition. When the stack is working hot, silicon and graphitic carbon will be high; when the furnace is cold and scaffolding, silicon is low, and combined carbon high. Malleable makers do not desire an iron in which the percentage of silicon is very high, or in excess, for there are many negative features encountered in such metal; but they do require an iron medium in silicon, and with a low total carbon. In all of the metals, the result of furnace manipulation, the lower the carbon, the softer or more ductile these materials will be, and malleable iron is no exception to this rule. To

affect a combination of irons in such proportions that the chemical reaction of the annealing process will have a certain effect toward the elimination of carbon in appreciable quantities, is the secret of all malleable practice.

In the casting of heavy shapes which do not require the maximum fluidity, it is found possible to use the "higher" brands of iron, from No. 4 to No. 6, because the carbon in such irons is in an advanced state of combination, and such castings being poured with this metal, cool very rapidly, retaining their original contour lines without segregation. Heavy castings poured with "low" metal, or metal high in silicon, would upon cooling, not only allow of segregation, but would also be "gray." This latter feature would be brought about, with the continued heat present in casting subsequent to cooling, allowing graphitic carbon, which had been in combination, to separate under conditions so very favorable. We all know the result of trying to anneal a "gray" malleable casting. It is invariably worthless, always burnt, because there has not been enough combined carbon present to offer resistance to heat of annealing ovens. The great features of malleable castings are malleability, ductility, and the ability to withstand heavy shocks, without losing the original lines of the same. These properties are not possible when the material after annealing has an excess of carbon present.

In looking over the analyses of both charcoal and coke irons, there is but a small difference noticed in the quantities of total carbon in all the grades from No. 1 to No. 7, and therefore the hope of procuring an iron low in total carbon seems very forlorn indeed. It is only in freak casts that such a condition is possible.

A COMPLEX CHANGE.

Transformation which takes place in a metal during its continuance in annealing ovens under high heat conditions, in which the carbon changes from the combined state, back to its original condition in pig metal, of graphitic carbon, is not altogether the result of this heat influence, for if it were, the carbon would not have been thus affected. The strains both internal and external would have been greatly relieved, and as in the instance of the

other metals, the annealing oven would have played its part. But in the annealing of malleable iron, the operation means more than ordinary explanation conveys. There is, of course, nothing which will accomplish this result but heat, and in this peculiar instance, it is accompanied by a chemical action, different in every particular from other annealing processes. It is virtually the turning backward of the carbon, with a loss, to the advantage of the metal. The fracture of an annealed casting and that of a gray iron casting differ in every particular. There is nothing in the original pig metal which suggests the change of fracture, for in the finished material there seems an altogether complete evolution in formation, and it is still within the limits of good reasoning to argue that the molecular formation in pig iron had entirely disappeared, giving place to an atomical creation, the proof of which suggests itself in the homogeneous character of fractures. It is hardly possible to "break" a good piece of malleable iron. The separation is more in the nature of cleavage than breakage; while in the instance of gray iron, it would be a break pure and simple. When castings of large diameters are being annealed, the operation is necessarily longer, as the carbon will not "let go" until a point beyond the highest heat unit of initial casting has been reached.

The idea is steadily gaining ground that, in connection with analyses of pig iron furnished founders, some knowledge of the initial heat conditions will at a future day be of the greatest assistance, for often we meet with a condition in malleable melting, and which follows the usage of both charcoal and coke metals, when the heat will be hot enough to tap, but the carbon is still holding off, and will not enter into combination until enough silicon has been burnt out, to reduce the excessive thermic condition in the bath. In looking over calculations made for these heats, one can seemingly gain nothing from the analyses, as there is nothing suggestive of the contingency. If we do not recognize a heat condition we are at a loss for an explanation. Just how this anticipated change will shape itself can be only a matter for conjecture, and should it follow the line of etching tests we will be in a measure prepared for it.

THE INFLUENCE OF SULPHUR.

Sulphur in pig iron is the most objectionable of all the metalloids. Being a product of a heat condition in blast furnaces (strictly speaking, coke stacks), it does not lose for one moment its power to work powerful effects at all times during the process. It is difficult for the modern manufacturer to accept sulphur as being beneficial, though this in substance is really being argued in several quarters. Excepting some special "off" grade of malleable in which a large percentage of sulphur is used for a special purpose, we know of no branch of metallurgy accepting it with favor. In charcoal iron, from the nature of ore and fuel used, sulphur is always at a minimum even throughout the "higher" gradings. In coke iron it is prominent not only through the influence of the class of fuel used in reducing the ore, but also in the ore itself. When the higher gradings of coke iron are reached, we find blast furnaces working cold, and the metal absorbing sulphur at a rapid rate. When this "high" iron is remelted in air furnaces the product, upon annealing, will show all those unmistakable characteristics found in steel making. Sulphur has affinity for nothing but itself; once in sufficient quantities it will invariably assert itself. The tendency toward permeation is so strong, that the metal will always be "short," with a decided inclination toward crystalline formation instead of a homogeneous construction. This latter feature is met with very frequently, and is sometimes difficult of explanation. Malleable concerns do not want, nor have they encouraged the use of, iron high in sulphur, and in the selection of coke iron, have repeatedly taken refuge behind the bulwarks of a Bessemer limit to aid them in purchasing. The absence of sulphur in charcoal iron has been recognized for years, as one of its strongest points. If coke furnaces would offer a uniform article in respect to sulphur, it could be used in malleable throughout all its various gradings. But on account of the atmospheric and other conditions which govern stacks, the "high" coke iron can never become a factor in the casting arts. There is no doubt but that sulphur in excess will combine carbon with the iron to a point higher than that attainable through simple furnace

operations, but this point is offset in malleable by the danger incurred in metal through this somewhat negative reasoning. The limits for sulphur in all irons offered should not exceed .045, to produce successful castings.

THE EFFECT OF PHOSPHORUS.

There seems at present a feeling among malleable makers that phosphorus in coke iron will be accepted with the same degree of confidence as was phosphorus in charcoal iron, in the early progress of the art. Malleable castings for many years were made from charcoal iron in which the percentage of phosphorus was rarely below 0.20, and yet with the introduction of coke iron phosphorus was regarded as extremely hostile to the process and iron was specified to the Bessemer limits. The supposed propensity was to cause metal to be "cold short" or brittle when cold. There has been no method devised as yet which will eliminate phosphorus in the blast furnace, and until the "basic" furnace is adapted to malleable purposes, it will be a condition to be met. Being organic and having affinity for oxygen, its combination with metallic iron is made by absorption, when metal is passing through the fusion zone of the furnace: When in the pig iron in appreciable percentages, it does not in the process of remelting for malleable purposes exert its influence in any degree, except under certain conditions, and those are when the latent heat of the metal is sufficiently high to free it. In metals graded Nos. 5, 6 and 7, phosphorus is at a standstill regarding heat conditions favorable for its action. We do not know in exactly what light phosphorus was considered in years gone by in malleable founding, but the theory has stood for a great while without proof that outside of its chemical reactions it made pig metal weaker physically.

In the old days the malleable mixtures were made up by the grading system, and iron was chosen with peculiar reference to the seggregation in fracture, even though it was all of the same quality. The distinction was made and the rule followed, that all iron, if uniform in structure, no matter what its quality may have been, yielded better and worked much more satisfactorily than it would have, if mixed with iron of varied fractures and analyses.

In other words, it was counted as unprofitable to melt weak iron with a stronger, as there would be a "melting loss" to meet far above the average. It is generally conceded (theoretically) that iron of the same composition, be it weak or strong, unites with the smallest losses. In the matter of loss in melting, where the percentage runs as high as 10 and 12 per cent of total weight charged, there would certainly appear ample field for improvement. When a heat of "high" iron is charged into the reverberatory air furnace, its yield is markedly greater than when a gray iron charge is compared, which has to undergo the boiling and oxidizing process which follows. The reasoning for this difference is only too obvious when considered for a moment. When the metal is hot of itself, and combined with the induced heat of blast, there is no question that phosphorus is the foundryman's friend for fluidity.

Manganese has gained more in favor during the past few years than any of the other metalloids. There have been many reasons for this, and its accepted worth is due to its ability to hold shrinkages within reasonable limits, together with its effect upon the final combination of carbon in bath. Its formation in pig iron is generally considered as an oxide and is, of course, readily affected by the flame of the blast. When in large percentages it acts as a flux in the distinct removal of sulphur. Manganese at high temperatures is acted upon by the burning of the silicon, and is thus converted almost entirely into a protoxide, which combining with the silicon in formation of slag, carries with it appreciable amounts of sulphur. Manganese, however, does not act, only when the heat conditions are above the normal, and this necessary feature will be recognized from the condition of slags drawn out of furnaces. The percentage of manganese specified for malleable pig iron has risen from the charcoal limits of .50 until now 1.50 is specified in many instances. The objection has been raised that these high percentages acting upon the carbon, render castings in the annealing ovens hard, making extra hard firing necessary to remove the carbon successfully. This latter theory has yet to be proved, and if it is so, it is of course acting

directly contrary to the theory of the malleable anneal, which is that any substance having an affinity for carbon, will remove the same under a high heat condition.

The original methods were somewhat different from those followed in many quarters, yet are still extant. Malleable cast iron is produced by a process of decarbonizing cast iron, by cementation; and the original method was packing castings in iron ore, which at a high heat imparted its oxygen to the carbon in the iron, forming CO. From this process arose the term hematite malleable iron. The adoption of automatic casting apparatus by blast furnaces, will enable them to offer the foundry user (and especially the malleable concerns) an article superior to the sand pigs of to-day. It is believed that the carbon will be in a higher state of combination with the iron, and it is hoped that the total percentage of carbon will be lower. The effect upon silicon content will be watched with great interest, as we anticipate some change in this particular, which will affect the grading. Metal which at hearth of furnace when tapped, showing two per cent silicon, will lose in some marked degree, upon the chilling consequent to the use of chill molds. If this furnace treatment should be very severe the subsequent handling must be along other lines than those at present pursued in malleable casting. Sandless pig iron brings with it a decidedly welcome feature of economy, both in fuel consumption, and obviating the removal of debris, which now follows a skimming of every heat. It is a most decided advancement in blast furnace product.

The adoption of standardized drillings is without question of great assistance, both to furnace managers, and founders, and another step which suggests itself in this connection, would be the adoption of uniform methods for laboratory analyses, by all parties concerned. We know for a certainty that blast furnace chemists will offer uniform results, when working upon the same sample, and by reason of this fact their analyses may be accepted without checking. Chemistry has not entered into the foundry industry to the extent one might suppose its unquestioned worth would warrant, and there are many reasons for this delay. You

can never tell whether there are two ways of producing a casting, until the second method has been tried, and it is the conclusion of those who have tried two ways, that chemists of sufficient breadth have accomplished and carried out more economies at the furnace, to the direct advantage of the metal, than all the rule-of-thumb melters. Encouragement here, more than in any other department of founding, has worked toward making output uniform and satisfactory.

AMERICAN MACHINIST.

R. D. Moore contributes an article to the issue of July 13 on "The Warping of Castings and the Remedy," in which he relates some observations noted by him in many years' contact with different kinds of foundry work.

In the issue of July 20, Mr. L. C. Jewett illustrates some of the humorous conditions that occasionally arise when departments of manual training schools are placed in charge of instructors who know nothing of the very trade they are supposed to teach.

THE FOUNDRY.

The stove foundry of the Walker & Pratt Mfg. Co. at Watertown, Mass., is illustrated in this journal for July.

"Holes in Cast Iron" and some phases relating to the same question are discussed by Mr. E. H. Putnam, who says:

"A hole is a very peculiar thing. In the first place, it is hollow, and therefore, the blast in the cupola would be much more apt to go right through it than to push it along up out of the stack. In the second place, holes evidently have a very strong affinity for cast iron. Charge the blast furnace never so carefully, instruct every workman connected with the business to use every possible precaution against permitting any holes to get in with the stock, and still the pig iron will be found to have more or less holes in it. It is my opinion that once a hole gets into the iron it is next to impossible to eliminate it. Melting of the iron does no good. You may dig a hole out of a piece of solid iron, but melt the iron and it clings to the hole with the most persistent tenacity. Besides, all holes are not alike. Stick your finger into a bucket of

water, letting it remain there for 20 or 30 seconds, then withdraw it and there will be no sign of a hole in sight; thrust your finger into a ladle of melted iron, permitting it to remain for the same length of time, and upon slowly and carefully withdrawing your finger there will be a hole; anybody can demonstrate this, and I maintain that it proves my theory that a hole in cast iron is different from other holes.

"It is not at all certain that the specific gravity of a cast iron hole is not at least as great as that of the iron itself. The evidence of this is in the location of the holes in a casting. If all holes were lighter than the iron they would rise to the top of the casting; but, as every foundryman knows, holes are located in all sorts of places. Take a roll that is being turned in the lathe; you will find holes anywhere from one end to the other sometimes, although the roll was cast on end. Talk of blowing such a hole up out of the cupola stack! You might as well expect to blow out the pig iron. Another evidence of the fact that a cast iron hole is heavier than the iron is found in the piece of stove plate with a blow hole in it; the opening of the hole to the surface is almost invariably on the under side, the upper face of the plate being perfect, except that just over the hole, or cavity, the scale of iron is very thin.

"And finally, the older men among the foundrymen of to-day will no doubt remember the tradition of how cannon were formerly made; for the benefit of the younger men it may as well be recorded here. The process was of the very simplest character. The foundryman simply made a nice smooth hole, set it up in the pit and poured the iron around it! And no man ever heard of the hole rising up through the butt of the cannon; it stayed right where it was put."

L. F. Bangerter writes of core sand which will clean easily from the casting, and advocates the use of the following mixtures:

"Cores for light castings, such as pump work, motors, valves, small cylinders and such, where core is almost wholly surrounded by iron and layer of metal is very thin, use white, or sugar sand, and if mixed with flour the proportion should be 20 sand and 1

flour; if rosin is used, about 1 rosin to 25 sand. This sand is fine and porous, needs no blacking, is easily rapped out and leaves the casting "slick as a whistle." For light castings no better sand can be found.

"For ordinary heavy castings, such as gun carriages, large cylinders, blast furnace and other heavy machinery, use lake sharp sand and red loam; proportions, 6 parts sand and 4 parts red loam; flour, 1 shovelful to 2 wheelbarrows of sand. Horse manure or sawdust, 1 to 6. Manure should be well dried and rubbed through No. 8 sieve. Black the cores with graphite and talc, one-half of each, and mix with molasses water. Apply heavy. For very heavy chunks, such as hammer blocks, when very small cores are used, mix sand two-thirds red loam and one-third sharp lake sand. Coal facing 1 to 20, and flour 1 to 20. Black with pure plumbago mixed with molasses water and apply one-quarter inch thick.

"For ordinary common work, like car work, agricultural and mining machinery, use red or 'Gordon' sharp sand 2 parts, and red loam 1 part; flour 1 to 20. Black with graphite and talc. For cores that are dug out while casting is hot, mix one-quarter red sharp, one-quarter red loam and one-half burnt core sand, flour one to twenty, saw dust one to six and black with graphite and talc. All core sand should be wet down with molasses water, one good handful of molasses to 1 bucket of water.

"No two shops mix core sand just exactly alike. I have been in the foundry nearly twenty-three years and have made cores in a number of different shops and cities and found a different variety everywhere; yet all gave good results, and coremakers who understand their trade find no difficulty in mixing good serviceable sand. To sum up: special cores require specially mixed sand, and while innumerable qualities can be met with, the brands I have given are thoroughly reliable and trustworthy."

R. H. Palmer illustrates the molding of a power press.

L. C. Jewett has an article on a "Removable Pin," showing the advantage of same to jobbing shops in general.

W. Roxburgh writes of "Dry Sand Facing," from which we take the following:

"While there are in my opinion strictures applicable to the milling of green sand facing, there can be none in dry sand, as a sand that is milled is in every conceivable way superior, both with regard to the preparing of it, ramming, finishing, venting, and a much stronger mold, the benefit of this latter being more appreciable on molds that have much chapleting.

"Again, there is much first-class facing sand by milling the loam that drops from the cakes and brickwork in emptying loam castings. With a supply of this material, one need have no dread of not getting a superior sand, supposing rock sand is out of one's reach altogether. Of course this by itself usually would be too strong; therefore, it becomes a matter with the man in charge to direct the proportions between that which is known to molders as black sand and the former. Probably this is one of the most positive foundry economics that we come in contact with every day when compared with those who foolishly consign the loam refuse to the dirt heap, which is usually the inevitable where no milling is in practice.

It is astonishing how some very poor sands can be improved by milling; but it is a fact that no matter whether we view it from a mineral or vegetable point of view, everything rolled, pounded, hammered or kneaded is toughened thereby. Thus it is that sand passing under the rollers in milling becomes improved to such an extent that it more than compensates for all the trouble. In case I may be regarded here as presupposing too much, the following may be taken as a recipe: Two or three shovelfuls of rock sand to a barrowful of black sand and milled, will make an average dry sand facing.

THE TRADESMAN.

E. H. Putnam contributes the following article on "The Treatment of Molding Sand."

Progress in foundry practice leaves nothing untouched that may serve advancement. The electric overhead traveling crane

is, perhaps, the most striking feature of modern development. It is not very long ago that the jib crane was the only style to be found in foundries. It was a slow and cumbersome affair, occupying much of valuable room, in itself, and between it, and numerous iron bars, boards, flasks and other impediments, there seemed to exist a natural affinity that generally proved stronger than the forces opposed thereto. To appreciate fully the great superiority of the traveling crane over the former style needs that the increase of product per man be taken into consideration, as well as the great improvement in appearance of the shop, and the comfort of working therein.

Undoubtedly every improvement in facilities, equipment and material raises the grade of product. Not least among these is the betterment in respect of molding sand that has been effected within the last few years. True, in some lines of work, in some foundries, this feature, namely, of suiting the sand to the character of the work, has received more or less marked attention for many years past, but considerable advance in this line has taken place in very recent years. It is nevertheless true that in, perhaps, the great majority of foundries, the attention to this feature never extends beyond tolerably careful selection of the grade thought to be best fitted to the work in hand. And, in many cases, one grade of sand is made to serve for molding all classes of work. It is no matter of wonder that such concerns have much difficulty with their work.

You cannot put a fine polish on a piece of casting by using a grindstone, alone; it takes, first, the grindstone, next, the emory wheel, and then the soft rag-wheel, or buffer. Neither can you produce the required surface on a thin, light casting by using sand that is appropriate for heavy gears and mill machinery.

In foundries where the handsomest stove plate is made, they are not content with any grade of sand as it comes from the pit; but it is first dried, then ground and sifted through a very fine mesh, before it is considered to be fit for the molding floor.

Many readers will think this a useless waste of time and labor, but, try it faithfully and thoroughly for a while, and you will change your opinion.

An American, viewing with admiration a splendid English lawn, asked the gardener how they had succeeded in making the surface so smooth and uniform in appearance, like a vast carpet of green. The simple answer was, in substance: "By a hundred years of painstaking labor." The axiom, "There is no excellence without great labor," is always true; whether applied to landscape gardening, painting, sculpture, literature or—iron founding.

An easy way to test the question as to whether the reduction of the sand by drying and pulverizing would greatly improve the appearance of the castings made in it would be to try a little of it; and yet, not one foundryman in fifty will do even this until competition shall compel him to.

Foundrymen have sometimes tried to achieve the desired result by compelling the molders to use fine riddles. But this plan is always, and very properly, a failure.

Very often the sand is shipped to the foundry in a wet condition and no attempt is made by the firm to dry it, or in any other way to make it fit for use. The molder is obliged to add it to his sand heap in this condition, with the result that it does not mix at all, but separates in masses of various size, and does not become properly incorporated for several days. Is it any wonder that castings flow and scab under these circumstances? Indeed, no. And is it any wonder that the use of a fine riddle is here impracticable? True, you may compel the molder to use the fine riddle; but you do not get the results that you are looking for. The molder well knows that he is expected to get up a good day's work, and he cannot rub mud through a No. 8 riddle and get to the back end of his floor on time; so, when the boss gets out of sight, though he still continues to use the No. 8 riddle, he does not cover the pattern with sifted sand, but finishes "with a coarse shovel," as he facetiously terms it. And do you blame him? If you have graduated through all the phases of foundry operations to the position of proprietor, you certainly cannot consistently blame him, for you did exactly as he is doing when you were "on the floor." The fact is, we lose a great amount of time while we are trying to accomplish the impossible.

Molding sand ought always to be placed in the storage bins in a dry condition. Failing in this, it should be artificially dried, ground and sifted before it is offered to the molder for use. Of course the character of the castings to be produced must determine the mesh of the riddle. The cheapest way for the foundry to accomplish this is to make special provision of drying furnace, pulverizing mill and power sifting machine. Where this is properly done the cost is but little, but the saving in prevention of bad castings will far more than cover the outlay, to say nothing of the benefits derived from greater general excellence of product. But the proper place for treatment of the sand, and the one where it may be most economically done, is at the pits where it is dug from the earth; and this practice is even now in vogue in some places, and it probably will be the general practice before many years. Of course, this applies only to sections where the foundries buy their sand from dealers. Where the foundryman is so situated that he must supply himself with sand the cost of treatment should be no bar, for the results will fully justify any necessary expense.

Large dealers in molding sand have opportunities of learning what grades to supply for any stated character of work, and it is best to deal with such when at all practicable. The dealer in molding sand is becoming as much a specialist as is the manufacturer of special lines of castings, and he knows, from practical experience with the trade, just what sand to furnish when the character of the casting is named.